

## EXECUTIVE SUMMARY

Historical mining activities in the Coeur d'Alene River basin (the basin) have resulted in widespread contamination of soil, sediment, and water. Metals resulting from these mining activities have washed into area creeks and rivers, have traveled down the Coeur d'Alene River into Coeur d'Alene Lake, and appear to have been deposited along portions of the Spokane River shoreline. Because the Spokane River is a major recreational area for people in the state of Washington and from out of state, there is a concern regarding human exposure to unsafe levels of metals along the river during summer beach visits.

This report provides the results of a screening evaluation of concentrations of metals in beach sediment at 18 selected sites, referred to as common use areas (CUAs), located on public and private lands along the banks of the Spokane River, from the Washington/Idaho border to the confluence with the Columbia River. The goal of this screening level human health risk assessment was to evaluate the CUAs and determine if further evaluation due to potential health risks is warranted.

A total of 253 sediment samples were collected from above the water line along the shoreline of the river and analyzed for the metals of concern. Sediment samples were collected at a depth of 0 to 12 inches along beaches where recreational digging is expected. Sediment was defined as material at the shoreline, from above the water line to below the high watermark. The metals of concern, selected on the basis of previous assessments of human health risk in the basin, are the following:

- Antimony
- Arsenic
- Cadmium
- Iron
- Lead
- Manganese
- Mercury
- Zinc

The risk assessment included an estimate of the beach sediment concentration of each of the metals that would be considered protective for people engaged in recreational activities along the river. This safe amount is usually referred to as a risk-based screening concentration (RBC). The RBC represents the concentration of a particular chemical in a particular medium (e.g., soil)

below which there is a high degree of confidence that a health threat does not exist. Once an RBC for each metal was determined, the actual concentrations of the metals found at the CUAs were compared to the RBCs. On the basis of this comparison, a decision was made about each CUA. The CUA was either excluded from further consideration because it was considered unlikely to pose a threat to human health, or it was designated for further evaluation to determine appropriate actions.

Because children are considered the most sensitive population group, RBCs developed to ensure protection of children are assumed to be protective of adults for noncarcinogenic metals. RBCs that are protective of children playing with beach sediment were developed for this risk assessment. RBCs developed for beach sediment assume that children will be exposed to beach sediment through ingestion and dermal contact and that they will ingest more sediment (i.e., eat more dirt) while playing at the beach than they would in their home setting on a daily basis. Because of the nature of the eight metals of concern, the dermal pathway was evaluated for exposure to cadmium and arsenic only. For the risk assessment, it was assumed that children would visit the river beaches 2 days a week (all day, for 10 or more hours) for 4 months out of the year (June through September). Because intake exposures for carcinogens (arsenic only) are doses averaged over a lifetime, combined child and adult exposures were considered in developing the RBC for arsenic. An RBC was developed for each of the eight metals of concern.

The RBC for lead was developed according to a procedure different from that used for the other metals. The current risk assessment method used by the U.S. Environmental Protection Agency (EPA) to evaluate health risks due to lead is based on a mathematical model called the Integrated Exposure Uptake Biokinetic Model (IEUBK Model). The IEUBK Model combines assumptions about lead exposure (environmental lead concentrations and intake rates) and lead uptake (absorption from air, diet, water, and soil) with assumptions on how lead behaves in the body to predict a blood lead concentration for a child between the ages of 0 and 84 months. In addition, an estimation of variation in blood lead is applied to the model assumptions to predict the distribution of blood lead levels in a population of exposed children exceeding a given level. The IEUBK Model predicted that, in a population of children exposed to the RBC of 700 ppm lead in beach sediment and to background concentrations of lead at home in air, soil, dust, drinking water, and food, 5 percent of children may have a blood lead level greater than 10 µg/dL. The average (mean) blood lead level of the exposed population was predicted to be 5 µg/dL. A blood lead level of 10 µg/dL is considered by the Centers for Disease Control and the EPA to be the target risk goal, or a level that poses an unacceptable risk to children.

For chemicals other than lead, RBCs were calculated by defining a target risk goal, then solving the basic EPA risk equations for soil concentration rather than for risk. Target risk goals and

equations differ for cancer effects and health effects other than cancer (noncancer effects). Target risk goals set by EPA for cancer risk are defined over a range of 1 in 1,000,000 to 1 in 10,000 ( $1 \times 10^{-6}$  to  $1 \times 10^{-4}$ ). The increased likelihood of cancer due to exposure to a particular chemical is defined as the excess cancer risk (i.e., in excess of a background cancer risk of 3 in 10, or  $3 \times 10^{-1}$ ). The risk is estimated as the upper-bound probability of an individual developing cancer over a lifetime as a result of the assumed exposure (i.e., average lifetime dose). For example,  $1 \times 10^{-6}$  refers to an upper-bound increased probability of cancer of 1 in 1,000,000 above the background rate over a lifetime as a result of the exposure evaluated. The target risk goal selected for this evaluation is 1 in 1,000,000 ( $1 \times 10^{-6}$ ), at the most protective end of EPA's range.

The target risk goal for noncancer hazards is typically represented by a hazard quotient of 1.0. A hazard quotient of 1.0 is the point at which the dose of a chemical due to exposures at the site equals the safe dose, or reference dose (RfD), of the chemical. The target risk goal used in this assessment was a hazard quotient of 0.1. One-tenth of the safe dose was assumed as a protective means of addressing the additive effect of doses of multiple chemicals and the effect of other complete exposure pathways that were not quantified at the screening level.

Once calculated, the RBC for each metal was compared with the background concentration of the particular metal in the Spokane River area. Background concentrations were taken from the results of a study by the Washington State Department of Ecology. If the RBC initially calculated was less than the background concentration, then the background concentration was used for screening purposes. Because metals occur naturally in soils and sediments, agencies usually take action only when concentrations exceed natural background levels. For two chemicals, arsenic and iron, the calculated RBC was less than natural background concentrations; thus, the background concentration for these two metals replaced the RBC for screening. The selected RBCs are presented in Table ES-1.

For each metal except lead, the RBC was compared to a 95 percent upper confidence limit ( $UCL_{95}$ ) of the mean concentration in sediment at each CUA. The lead RBC was compared to the mean concentration. Generally, measured concentrations of the metals were highest upstream of the Upriver Dam pool (that is, approximately river mile 84) and were considerably lower downstream of this area.

The arithmetic mean concentration of lead in beach sediment at each CUA was compared to the lead RBC. Of the 18 CUAs evaluated, only River Road 95 had any arithmetic mean sediment concentration that exceeded the RBC. Therefore, River Road 95 was retained for further evaluation.

The  $UCL_{95}$  for arsenic was greater than the RBC at 10 of the 18 sites. However, of these 10, 6 sites, with concentrations in excess of the background level, were classified as sites that pose sufficiently low health risk to children and eliminated from further investigation: Harvard Road S., Plante Ferry Park, People's Park, Riverside Park at W. Fort George Wright Bridge, Jackson Cove, and Horseshoe Point Campground. These six sites do not warrant further evaluation for the following reasons:

- The concentrations of arsenic were only slightly greater than the natural background concentration of 10 mg/kg.
- The arsenic concentrations at the six beaches ranged from 12 to 16 mg/kg, which may be within the natural background range for fine particles of river sediments.
- The additional cancer risk from exposures to arsenic concentrations of 2 to 6 mg/kg greater than the background concentration is not significantly greater than the risk due to naturally occurring levels of arsenic (an increase in the chance of developing cancer of 1 to 2 in 1,000,000).

The remaining four sites were classified as sites that pose possible risk to children, and they were selected for further evaluation due to the presence of arsenic or lead in sediments. The  $UCL_{95}$  arsenic concentration at these four sites exceeded the RBC for arsenic (10 ppm):

- 201 - River Road 95 (29.3 ppm)
- 202 - Harvard Road North (20.2 ppm)
- 204 - Barker Road North (36.2 ppm)
- 205 - North Flora Road (21.4 ppm)

The mean lead concentration at Road 95 (1,400 ppm) also exceeded the RBC for lead (700 ppm). No other metals exceeded the RBCs at any other CUA along the Spokane River.

**Table ES-1**  
**Risk-Based Screening Concentration Selected for Each Metal of Concern**

<b>Metal</b>	<b>Calculated RBC (ppm)</b>	<b>Background Concentration in Spokane Area (ppm)</b>	<b>RBC Used in Screening (ppm)</b>
Antimony	23	Not available	23
Arsenic	3	10	10
Cadmium	49	0.7	49
Iron <sup>1</sup>	17,109	27,000	27,000
Lead	700	16	700
Manganese <sup>1</sup>	7,984	769	7,984
Mercury	17	0.1	17
Zinc <sup>1</sup>	17,109	71	17,109

<sup>1</sup>This metal is an essential nutrient, that is, people need some of the metal in their diets to be healthy. The screening level shown is less than the nutritional requirement for the metal. Therefore, concentrations greater than the selected RBC are not likely to pose a health concern.

Notes:

ppm - part per million

RBC - risk-based screening concentration